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NEMATODE DISEASES OF CULTIVATED PLANTS

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In the Soviet Union little study has been made of the distribution of nematode plant parasites and of the damage they cause in all branches of plant breeding. During the past few years, prognostic centers have begun to reckon with nematode diseases, but, unfortunately, personnel equipped to deal with these parasites are almost entirely lacking at the local level, and since nematode identification even at best is a difficult matter, information submitted is not always accurate.

Since 1963 periodic symposia have been published to serve as brief summations of research conducted on parasitic nematode distribution and damage in the USSR. ( )

The present symposium embraces 1963 - 1964 data drawn from reports and summaries submitted to the Prognosis Laboratory of the All-Union Institute of Plant Protection; it includes, in addition, some published material not included in the first symposium.

The information referred to was received from Sectors and prognostic centers, from Central Quarantine Laboratories of Republic, Kray and Oblast Quarantine Inspections and Plant Protection (A. M. Borovkova, V. I. Belokurskaya et al.), and from the Division of Plant Protection, Ministry of Agriculture RSFSR (I. K. Nikulina). Use was made of the reports of the All-Union Institute of Plant Protection and those of its stations (N. M. Sveshnikova, T. G. Terent'yeva, K. I. Borozdina, V. P. Yefremenko, L. A. Gus'kova, D. M. Sadykhov, V. S. Treskova, S. V. Kapitonenko, B. P. Rasinya, E. Ya. Razauska, E. Ya. Erenfel'de and O. M. Zhuk). In addition, data were received from the colleagues of various other institutions: E. A. Krall' (Institute of Zoology and Botany, Academy of Sciences Estonian SSR), A. A. Ustinov (deceased) and V. G. Zinov'yev (Institute of Biology of Khar'kov State University), E. M. Drozdovskiy and O. Z. Metlitskiy (Zonal Institute of Horticulture of the Non-Chernozem Belt), and B. G. Ivanenko (North Caucasus Zonal Institute of Horticulture and Viniculture).

The stem nematodes (Ditylenchus spp.) are very widely distributed in the Soviet Union. This genus includes nematodes which parasitize a great variety of crops -- the onion family (onion, garlic, narcissus), the potato, various grains, root crops, berries, flowering plants (phlox), fodder grasses (clover, etc.) -- and also weeds.

At the present time taxonomists do not agree on the species to be included within this genus. Some consider that two species can be clearly distinguished -- the potato stem nematode (D. destruktor Thorne 1945), and D. dipsaci (Kühn, 1957 Filipjev, 1936), which parasitizes cultivated plants and is possibly a variety of the former. But other taxonomists distinguish a number of species of stem nematodes -- the onion nematode (D. allii Beijerinck, 1883) Filipjev a. Schuurmans-Stekhoven, 1941, 1945/, the strawberry nematode (D. fragariae Kirjanova, 1951), and the phlox nematode (D. phloxidis Kirjanova, 1951), among others.

This whole question is being re-examined at the present time. In the present synopsis we employ a nomenclature with differentiation of species.

The stem nematode of the potato (Ditylenchus destructor Thorne, 1945) attacks the surface of the pulp, which narcotizes, turns brown, and falls away from the skin; dark spots form on the tuber, the skin being cracked where they occur. For many varieties of potato the damage is apparent at harvesting; more often it is noticed during storage, and especially when sorting potatoes for seed. Infected tubers eventually rot; losses during potato storage amount to 40 percent or more. The range of this disease is continually increasing, since seed potatoes are shipped around the country without control of their quality. Potato losses due to nematodes are on the rise, the more in that the parasites survive in the soil after the infected potatoes have been harvested.

This species also attacks the carrot; it has been known to damage peas and beans; and it can remain viable in buckwheat and a number of other crop plants, and also weeds (Ye. F. Tereshchenko, 1957; S. V. Kapitonenko, V. P. Yefremenko et al.).

Damage from this species was noticed almost 30 years ago in Kurskaya Oblast (Ye. S. Kir'yanova, 1936); in recent years it has appeared in 15 oblasts (Synopsis for 1962). N. K. Nikulina reports, in addition to this, that it has appeared in Lipetskaya and Rostovskaya oblasts. The parasite was reported from Ul'yanovskaya Oblast in 1956. The "Pamyat' Il'ich" kolkhoz reports heavy damage among 60 tons of seed potatoes; the "Tretiy god pyatiletki" kolkhoz, Ul'yanovskiy Rayon, reports massive infection in potatoes of the Lorkh variety; and the Ul'yanovsk Potato Experiment Station found a loss of 21 tons of the seed stock of the Volzhanin variety.

The plant protection station (PPS) of Bryanskaya Oblast reported that for 1963 this species of nematode caused rotting of potatoes stored in pits and depositories at the kolkhozes of Klintsovskiy Rayon -- "Leninskiy put'", "Boyevik," "Pravda," "Put' k kommunizmu," and "Put' k kommunizmu." There is reason to suspect the presence of the disease at other farms as well.

The Tambovskaya Oblast PPS reports that autumn 1963 tests run on potatoes from Sosnovskiy, Tambovskiy, and Morshanskiy rayons revealed infection in 0.3 to 5.1% of the crop. The disease attacked various varieties as follows: at the "Sukhotinka" sovkhoz, Lorkh by 0.4% and Berlikhingen by 5.1%; at the "Tambovskiy" sovkhoz, which used pits for storage, the Lorkh variety by 0.3 - 0.4%, and the Vol'tman by 0.4 - 1.8% (these two farms are in Tambovskiy Rayon); at the "Pamyat' Lenina" kolkhoz, the Lorkh was infected by 0.4% (Sosnovskiy Rayon). There is information from the Tuvinskaya ASSR that nematode disease has attacked potatoes in Tes-Khemskiy Rayon, but the reports must be clarified. In 1960 nematode infection of potato tubers was found on seven farms in Rostovskiy Rayon, Yaroslavskaya Oblast: imeni Michurin (villages of Bakki, Khonyatino and Gupronikha), as much as 10 - 30% infection; "Put' Lenina" (Sokolovo, Turovo), 5% (the Ostbote and Lorkh varieties); the "Rostovskiy" sovkhoz (Smerdino), 1 - 5%; the "Pobeda" kolkhoz (Dertniki and Nikitino), 1 - 3% the "Druzhba" kolkhoz (Shchipachevo, the Berlikhingen variety); the "40 let Oktyabrya" kolkhoz (Godenovo, Lorkh variety); and the "Zarya" kolkhoz (Kayurovo, the Epron variety). The infection attacked even large consignments of potatoes -- from 50 to 100 tons.

At the "Politovo" sovkhoz in Dankovskiy Rayon, Lipetskaya Oblast, the stem nematode was found over an area of 375 hectares, and the entire harvest had to be sent to a starch and sugar refinery. Information received from the PPS of Lipetskaya Oblast indicates that in 1963, at the Yeletsk Experiment Station, the infection was found in 1% of the seed stock.

Infection of 14% of tubers of the Kazhestik, and 4% of tubers of the Yuzhanin varieties, was found in 1957 in Aksayskiy Rayon, Rostovskaya Oblast.

The potato nematode is widespread in the Ukrainian SSR. The first information on the appearance of nematodes in Vinnitskaya and Odesskaya oblasts was published by Ye. S. Kir'yanova in 1936). In the earlier symposium (1961 - 1962) it was reported that the disease had been recorded in oblasts of the republic. In 1963 the potato stem nematode was observed in Kiyevskaya Oblast. The infection rate was not high, however, because of conditions unfavorable for the parasite (dryness). Tests made on tubers showed that at the "Baryshevskiy" sovkhoz, during the harvest, the infection was not present in more than 1% of the crop; the figure was 0.5% for the imeni Komintern kolkhoz.

In 1961 - 1964 selective samples were taken from the Cis-Carpathians. The results showed the presence of the potato stem nematode in some of the rayons of L'vovskaya Oblast (Pustomytovskiy, Sokal'skiy, Drogobychskiy, Stryyskiy, Brodovskiy), Chernovitskaya Oblast (Storozhinetskiy, Glybokskiy, Kitsmanskiy, Novoselitskiy), and Ivano-Frankovskaya Oblast (this information was reported by S. V. Kapitonenko). The distribution and infection rate are shown in Table 1.

Table 1

Infection of Potatoes with the Stem Nematode in the Cis-Carpathians at Harvest Time, 1961 - 1964 (data of S. V. Kapitonenko)

Year	Number of Units Studied					Percent if Infected Tubers
	Rayons		Farms			
	Total	Number of Units in Which Nematodes Were Observed	Total	Number of Units In Which Nematodes Were Observed	Percent	
			L'vovskaya Oblast			
1961	3	3	11	11	100	1--32
1962	2	2	3	3	100	1--3
1963	4	4	9	8	88	0,3--4,0
1964	5	4	8	6	75	0,8--12,0
			Ivano-Frankovskaya Oblast			
1963	3	2	7	3	43	0,3--0,7
1964	2	2	5	3	60	1--5
			Chernovitskaya Oblast			
1963	4	4	8	8	100	0,3--12,0
1964	5	5	7	6	85	0,3--6,0

The report issued by the Chernigovskaya Oblast PPS notes the wide distribution of the stem nematode both on kolkhozes and on the private plots of the kolkhoz members. Spring tests run on potatoes at the imeni 40 let Oktyabra kolkhoz in Bobrovitskiy Rayon in 1963 showed strong infection of the following varieties: Vol'tman, 52%; Yubel', 39%; Al'ma, 35%; Rannyaya roza, 11.0%; and Zazernaya, 8.0%. Tests run in 1964, at the time of harvest, showed the same strong infection of the Vol'tman (32.7%), Yubel' (24.0%), Maynkrop (29.0%) and Rannyaya roza (42.8%) varieties.

The report of the Repki prognosis center (Chernigovskaya Oblast) for 1964 indicated infection of 2 - 8% of 800 centners of seed potato of the Vol'tman variety at the imeni Lenin kolkhoz; and infection of 20.2% of 200 centners tested in the spring at the "Zapoviti Lenina" kolkhoz (Vladimirovka, same oblast). The Priluki prognosis center (same oblast) reported infection rates of 8% and 12% for the Vol'tman and Rannyaya roza varieties, respectively. At farms of the Chernigovskaya Experiment Station the infection of tubers reached 6%.

In Sumskaya Oblast the stem nematode is widely dispersed in all rayons. The oblast PPS, after testing tubers in the winter of 1962, found infection

rates as high as 16% in the southern rayons; in the central and northern rayons it ran from 3 to 10%. The 1963 harvest was found to be infected by 9 - 12% in the southern rayons, and by 0.8 - 3% in the central and northern rayons. The Akhtyrka prognosis center reported that before planting an infection rate of 25% had been reached in potatoes stocked at the imeni Petrovskiy kolkhoz. The Sumy prognosis center in 1963 found infection rates of 0.1 - 0.3% in trench-stored potatoes of the Yubel' and Vol'tman varieties ("1 Maya" and imeni Lenin kolkhozes). The Putivl' prognosis center reported an infection rate of 10% for potatoes stored in pits and depositories.

In Khar'kovskaya Oblast, the Bogodukhov prognosis center reported the following infection rates for 1963: at the imeni 17-yy kolkhoz, 2.8% (Turka variety); at the "Peremoga" kolkhoz, 1.3% (Berlikhingen); in potato depositories of Kupyanskiy Rayon, 3.5%. Private plots adjoining kolkhoz lands showed rates of 10 - 15% (A. A. Ustinov and V. G. Zinov'yev). These observers point out that carrots offered for sale frequently carry the potato stem nematode.

In Zhitomirskaya Oblast the Karnea and Ostrovskiy varieties were found to be 4% infected before planting and 8.6% infected in the autumn (1962; imeni Shevchenko kolkhoz).

In Dnepropetrovskaya Oblast, according to data submitted by the Vasil'kovka prognosis center, a 6-hectare seed plot exhibited a 2% infection rate (these potatoes were originally imported from Kiyevskaya Oblast) in 1963.

In Poltavskaya Oblast, in 1963, seed potatoes were found to be 5% infected, and in Karlovskiy Rayon the figure reached 7.5%. The highest rate was found in Mirgorodskiy Rayon -- 38.6%.

The infection was reported in Kovel'skiy Rayon, Volynskaya Oblast, by S. V. Kapitonenko.

In the Belorussian SSR, infection with the potato stem nematode has been observed in Gomel'skaya, Minskaya, and Bretskaya oblasts (See Table 2).

The Gomel'skaya Oblast PPS reports the presence of the potato stem nematode throughout the entire oblast, including the seed farms. The data of tuber analysis conducted by the station, prognosis centers, and seed-control laboratories, indicated that all varieties of potato suffer from the parasite. The Gomel' prognosis center (1963 report) in spring tests observed infection rates of 5.1% (Ostbote variety; imeni Lenin kolkhoz), 25.1% (same variety, "Pobeda" kolkhoz) and 19.7% (Agronomicheskiy variety, "Pobeda" kolkhoz). The oblast experiment station "Dovsk" found a 3.4% infection rate for the Foran variety. The imeni 22-yy s"yezd KPSS observed infection rates of 2.3% for the Foran variety, and 14.5% for mixed varieties, just previous to storage (1963). At the "Pobeda" kolkhoz the Foran variety was found to be 46.4% infected. In 1963 the "Lipovo" experimental center found an infection rate of 3.2%, the Foran variety exhibiting 1.9% and the Ostbote elite 0.2%.

Table 2

Distribution of Potato Stem Nematode in the Belorussian SSR
1958 - 1962

(Report of the Minsk Plant Protection Station of the All-Union Institute of Plant Protection)

Rayon	Number of Farms Where Infection was Detected	Tuber Infection Rate
Gomel'skaya Oblast		
Dobrushskiy	3	0.2 - 0.5
Mozyrskiy	3	4 - 8
Petrikovskiy	1	1,6
Rechitskiy	1	15,0
former Terekhovskiy	4	1 - 30
Khoyninskiy	1	1 - 13
Svetlogorskiy	2	1 - 12
Vetkovskiy	1	1,0
Braginskiy	2	1,4 - 3,0
Kalinkovichskiy	1	1,5
Rogachevskiy	3	1,0 - 24,8
Narovlyanskiy	3	3 - 5
Yel'skiy	5	1,5 - 9,5
former Oktyabr'skiy	3	0,3 - 0,9
former Kormyanskiy	3	0,4 - 2,2
Chechерskiy	1	10,0
Zhlobinskiy	1	1,2 - 6,7
Gomel'skiy	5	8 - 29
former Uvarovichskiy	1	9,3
former Konovskiy	1	11,0
former Komarinskiy	8	0,5 - 6,0
Brestskaya Oblast		
Pruzhanskiy	1	1 - 14
Kamenetskiy	1	18 - 30
Baranovichskiy	1	24,0
Minskaya Oblast		
Minskiy	2	2 - 57
Chervenskiy	1	1
Molodechnenskiy	1	47
Dzerzhinskiy	1	no information

The "Dvarovichi" experimental center found an infection rate of 2.1% for the superelite Foran, 1% for the elite Foran, and 0.2% for the elite Ostbote. At the "Mosnal'" sovkhoz, the elite Agronomicheskiy was 0.2% infected. Spring tests in 1964 showed that nematode infection rate for the oblast ranged from 0.2 to 38%.

In Minskiy Rayon, Minskaya Oblast, infection rates of 1.5 - 2% were found for the Loshitskiy, Skorospelka, Zaberezhy and Foran varieties after sorting, at the "Rusinovichi" and "Kazan'ye" elite seed farms; before sorting, the figure was 8% for the "Rusinovichi" farm. The rate at the "Molodino" farm was 2% (L. A. Gus'kova).

In the Moldavian SSR the potato stem nematode has been observed in the former Slobodzeyskiy, Sorokskiy, Dubossarskiy, the former Bel'tskiy, and Tiraspol'skiy rayons (F. I. Nemchin, Ye. P. Okhova, 1957); strong infection has been observed on the plots of the Scientific-Research Institute of Irrigation Agriculture and Horticulture, close to the city of Tiraspol' (1962 symposium).

In the Georgian SSR the parasite is found in all potato-growing districts. At harvest time an infection rate of up to 18% has been recorded, and this rises to 30 - 40% in the spring (L. P. Kalandadze et al., 1959).

In the Azerbaydzhan SSR the potato stem nematode is found in the Kusarskiy, Yardamlinskiy, Kedabekskiy, Khanlarskiy, Shamkhorskiy and Lerikskiy rayons (1962 symposium). Moreover, G. A. Kasimova reports (1952, 1963) that this species has infected potatoes in Lenkoranskiy and Kubinskiy rayons, and on the Apsheron Peninsula -- in the former Mashtaginskiy Rayon and at Shuvelyan. In 1962 - 1963 the parasite was observed by G. M. Ismailov in Kazakhskiy Rayon. Ismailov's observations indicate that it exists throughout the western part of the republic. Table 3 indicates the degree of damage suffered from the nematode in the western part of the Azerbaydzhan SSR.

In the Armenian SSR the potato stem nematode is found everywhere potatoes are grown (a 10 - 20% infection rate is normal). In August 1950, 80% of stalks on the fields of some of the rayons of Spitakskiy Rayon were found to be infected (E. Ye. Pogosyan, 1951, 1954). In 1963 a test run on seed potatoes showed a 7.2% infection rate. The report of the Armenian Scientific-Research Institute of Agriculture reports autumn infection rates of 7.3%, 0.1% and 3.6%, for the Aparanskiy, Sevanskiy and Martuninskiy rayons, respectively.

The potato stem nematode is widespread in the Baltic republics. It has been known in Latvia since 1951 (B. P. Rasinya, 1951). In 1963 the nematode was discovered in the Yekabpilskiy and Rizhskiy rayons ("Elkshin," "Draudziba" and "Baldone" kolkhozes: 4%, 3% and 13.7%, respectively), and also at the experimental farm of the Baltic All-Union Institute of Plant Protection ("Tsarnikava"), where the infection of tubers amounted to 2.1%. By 1964 the nematode had appeared in six out of the 21 rayons of the republic -- Kuldigskiy, Dobel'skiy, Rizhskiy, Orgskiy, Yekabpilsskiy and Bauskiy (E. Ya. Razauska, E. Ya. Erenfelde, B. P. Rasinya). Infection rates on some farms reached as high as 20% (D. K. Kaktynya, 1962).

Table 3

Damage from the Potato Stem Nematode in the Western Part of the Azerbaydzhan SSR

(data of G. M. Ismailov)

Rayon	Potato Infection Rate		
	Stalks (Autumn 1962)	Tubers Autumn 1962	Tubers Spring 1963
Fermer Kedabekskiy . . .	8,6 - 20,9	1,6 - 27,8	5,6 - 26,4
Kazakhskiy	16,4 - 41,8	2,2 - 25,7	19,2 - 34,3
Khanlarskiy	12,7 - 16,4	2,2 - 19,4	9,6

E. L. Krall' has noted the presence of the potato nematode in the Estonian SSR, with tuber infection rates as high as 7%. More specific information has not been supplied.

In the Lithuanian SSR the parasite was observed in 1959 in Kel'meskiy Rayon. Subsequently it appeared in other areas, by 1961 being found in Kapsukskiy, Kel'meskiy, Kretingskiy, Mazheyskiy, Panevezhskiy, Plungeskiy, Shakyayskiy, Radvilishskiy and Shvenchenskiy rayons (report of the Lithuanian PPS of the Central Institute of Plant Protection for 1961). Infection of up to 10% of potatoes was found in Kel'meskiy and Panevezhskiy rayons.

In the Kazakh SSR, the potato stem nematode was observed in 1958, on the plots of the Republic Potato Experiment Station and Vegetable Farm; here the infection reached 15%. In the case of a farm close to Alma-Ata, the infection of potatoes of the Rekord variety was so severe that the crop was entirely unfit for storage (S. F. Saf'yanov, 1964). In 1963 Saf'yanov had observed the parasite in sorted potatoes from Enbekshikazakhskiy and Gvardeyskiy rayons of Alma-Atinskaya Oblast, and from Dzhuvalinskiy Rayon of Dzhambulskaya Oblast, with infection rateof 13.7%. At the imeni 2-ya pyatiletka kolkhoz, 44.6% of the harvest was infected. In Karagandinskaya Oblast (as stated in the report of the oblast PPS) analysis of tubers in large stores in the winter of 1962 revealed the presence of nematodes in 1.2%. In Tel'manskiy Rayon (same oblast) the prognosis center found infection rates from 14 - 37% in spring analyses, and up to 20% in autumn analyses; in this connection, the Rekord variety was infected by 1.6 - 17%, the Berlikhingen by 2 - 13%, the Karagandinskiy by 1.5%. At the "Pobeda Il'icha" sovkhos in Kokchetavskaya Oblast, the Berlikhingen variety was infected by 0.6% (report of the oblast sector of the prognosis service). The Petropavlovsk prognosis center reported the presence of nematodes in Severo-Kazakhstanskaya Oblast.

In the Uzbek SSR the parasite is encountered quite frequently (A. T. Tulaganov, 1954).

From this summary, which is far from complete, it is evident that the potato stem nematode is widely distributed in the Soviet Union, and that it is the cause of a considerable degree of infection and heavy losses of potatoes.

* * *

The onion stem nematode /Tylenchus allii (Beijerinck, 1883) Filipjev Schuurmans-Stekhoven, 1941/ attacks onions and garlic, causing heavy losses of these valuable vegetables. The plants may be destroyed in the field, but are especially susceptible in depositories. The nematode multiplies in the bulbs, causing splitting of the stem of the onion, and its destruction in the case of garlic. The bulbs rot, and the nematodes infect the surrounding soil in massive numbers. On numerous occasions such rotting bulbs, left in the ground or returned there as part of waste materials used as "organic fertilizer," have saturated the soil with nematodes.

Upon sowing in contaminated soil, the seedlings become abnormally swollen and twisted, since they have already been infected with the nematode. If the seedlings do not die, their development is at least retarded, the leaves are shriveled, and the bulbs are split. The nematode-infected set which forms by autumn may have cracks or whitish spots at the basis of the husk, where nematodes are harbored. A strongly infected set dries up during winter storage, becomes undersized, and loses the power to germinate.

Among infected onions, when the set matures into a full bulb, the ends of the leaves wither and the stalks thicken and crack. By harvest time the stalk has split into 2 - 4 sections, and sometimes the husks are separated from the unsplit bases.

Among infected garlic plants the leaves are shriveled and are dried out at the ends. When the plants are pulled out of the ground, the outer covering readily separates from the bulb, the stem is destroyed, and the bulb separates into cloves which remain in the ground.

This disease is widespread in old onion-growing areas, particularly the private plots of kolkhoz members. Heavy losses were observed as early as 1935 (N. M. Sveshnikova, 1936) at the village of Kichanzino, Gor'kovskaya Oblast. It has now spread to many other regions of the country (See the Symposium for 1962).

In 1953 - 1954, in Rostovskiy Rayon, Yaroslavskaya Oblast (See the report of the Moscow PPS of the All-Union Institute of Plant Protection), onion crops infected from 3.4 to 38.5% were observed in 50% of the kolkhozes studied. Of 18 private plots studied, 15 were found to contain infected onions, and the infection rate was high -- from 71 to 100%. The Rostov prognosis center in 1963 reported that a two-hectare and a four-hectare onion plot at the imeni Michurin kolkhoz were 2% infected.

Private plots in Arzamasskiy Rayon, Gor'kovskaya Oblast were infected by 19% in 1953. In 1962 in Kstovskiy Rayon (same oblast) a 1% infection was found on a 33.7-hectare onion plot (M. K. Nikulina). In 1964 the nematode was observed in commercial onions at the "Zarya" kolkhoz, on a 24-hectare plot, at the "Mirovoy Oktyabr'" kolkhoz on a 50-hectare plot, and at the "Zhivotiovod" kolkhoz on a 5-hectare (data reported by the Gor'kovskaya Oblast' PPS).

The stem nematode has also been discovered (data of M. K. Nikulina) in Kurskaya Oblast, Shkotovskiy Rayon of Primorskiy Kray, and Kurimanovskiy of the Bashkirskaya ASSR.

In July 1964, N. M. Sveshnikova and colleagues of the Ivanovskaya Oblast PPS, found that some three hectares of flooded onion and garlic fields at the "Ivanovskiy" sovkhoz had been completely ruined by the nematode. On 22 private plots belonging to inhabitants of the city market of Ivanovo it was easy to find local onions which had been infected with the parasite, and similar products imported from the city of Shuya and from Suzdal', in neighboring Vladimirskaya Oblast.

Information bulletins from the Volgograd PPS report that in June 1964, some infection by nematodes was found in a 4-hectare plot in Srednekhtubinskiy Rayon.

In the Ukrainian SSR the stem nematode has infected onions in L'vovskaya, Zakarpatskaya, Donetskaya and Belgorodskaya oblasts (A. A. Ustinov, V. G. Zinov'yev), and has been found in private gardens at the settlement of Vasil'kovka, Dnepropetrovskaya Oblast, where the number of infected plants reached 37 - 40% (data supplied by the Vasil'kovka prognosis center).

In Abkhazia, the disease is found in private plots (Ye. S. Kir'yanova, 1955).

In the Lithuanian SSR the onion stem nematode was observed first in 1959, on a private plot near the city of Vil'nyus (V. P. Yefremenko).

The onion stem nematode is unquestionably being distributed through shipments of infected seed onions, since it has been discovered in the stocks of the "Sortsemovoshch" association. Garlic sets, being scarce, are often taken from private plots, and find their way into the kolkhoz fields. When preparing sets, it is necessary to make a careful examination and eliminate any nematode-infected plants, which can be grown separately for their foliage.

* * *

The strawberry stem nematode (Ditylenchus fragariae Kirjanova, 1951) is the most harmful parasite infecting this fruit; it may reduce the harvest from 50 to 90% (V. P. Danilov, 1954; M. S. Chernikova, 1959; O. Z. Metlitskiy). Many observers report that strongly infected plants develop poorly; the leaf blades become wrinkled and underdeveloped; the buds lack full coloration and

Table 4

Susceptibility of Various Varieties of Strawberries to Nematode Infection in the Krasnodarskiy Kray (data of E. G. Ivanenko)

Farm	Variety	Infected area (hectares)	Infection rate (%)	Year planting	Analysis
"Mikhaylovskiy pereval" kolkhoz	Chernobrivka	0.5	30	1959	1961
		1	25	1960	1961
		1	28	--	1962
	Prevoskhodnaya	1.6	26	1959	1961
		1	27	--	1962
Auxiliary farm of the Abinsk Cannery	Chernobrivka	5	100	1959	1961
		7	80	1960	"
	Kul'ver	3.5	100	1959	"
		2.5	100	1960	"
	Ranyaya MosVIR	3	100	1959	"
	Lyubimitsa	5.2	75	1960	"
	Adagumskaya	2.5	37	1960	"
	Yuzhanka	0.5	91	1960	"
Crimean Fruit and Vegetable Experiment Station	Chernobrivka	1	100	1959	"
	Ranyaya MosVIR	0.8	100	1958	"
	Prevoskhodnaya	0.5	100	1959	"
	Kul'ver	0.5	100	1959	"
	Lyubimitsa	0.5	68	1958	"
	Adagumskaya	0.5	32	1959	"
	Yuzhanka	0.2	100	1959	"
	Krasnodarskaya ranniyaya	0.5	63	1958	"
	Syurpriz	0.3	100	1959	"
	Krasnodarka	0.5	100	1959	"
	Komsomolka	0.5	100	1959	"
	Galochka	0.5	27	1958	"
	Dessertnaya Kubani	0.2	23	1959	"
	Iosif Magomet	0.2	63	1958	"
	Tystavochnaya	0.5	28	1958	"
"Sad-Gigant" sovkhoz	Ranniyaya MosVIR	2	100	1960	"
	Kul'ver	1	100	1958	"
	Lyubimitsa	1.5	31	1960	"
	Adagumskaya	2.5	31	1960	"
	Komsomolka	1.2	100	1958	"
	Poadnyaya iz Zagorska	1.4	10	--	1962
	Rubinovaya	1.4	5	--	1962
	Krasavitsa	1	33	--	1962
Fruit & berry sovkhoz of Labinskiy R.	Chernobrivka	3	19	1960	1962
		4	5	1961	1962
		25	15	1958	1961
		2	18	1959	1962
	Yuzhanka	1	12	1960	1961

exhibit swellings and cracks; the floriferous shoots and runners are dwarfed. The plants give the appearance of having been infected with the earth mite, but the presence of swellings on the leaf stems and runners points clearly to nematode infection; however, in the case of mild infection, and with some less susceptible varieties, the swellings are not very prominent (O. Z. Metlitskiy). The nematode attacks more than 40 varieties of strawberry (A. M. Borovkova), including some of the most valuable -- the Komsomolka, the Kuto, the Rannyaya MosVIR and the Iosif Magomet. The susceptibility of various varieties is illustrated in Table 4.

The strawberry nematode also attacks the potato, red clover, buckwheat, and more than 20 weed species (O. Z. Metlitskiy), particularly the purslane (N. M. Svechnikova) and the cinquefoil (V. G. Zinov'yev, N. M. Ladygina).

The strawberry nematode migrates mainly through infected seedlings, runners, soil and water.

In the RSFSR the strawberry stem nematode has been observed (apart from the oblasts covered by the 1962 Symposium) in the Belgorodskaya, Volgogradskaya, Voronezhskaya, Kaluzhskaya, Novosibirskaya, Orlovskaya, Rostovskaya, Ryazanskaya, Sverdlovskaya and Tyumenskaya oblasts, and in the Severo-Osetinskaya and Chuvashskaya autonomous republics, as well as the Primorskiy Kray (at Ussuriysk) (information of A. M. Borovkova).

O. Z. Metlitskiy reports that in Moskovskaya Oblast the nematode has been found at the settlements of Michurinets and Vostryakovo (about 10 foci), in Aprelevka and Kokoshkino (Naro-Fominskiy Rayon: at the fruit experiment station of the Timiryazevskiy Agricultural Academy on a 0.6-hectare plot (area of the foci amounting to 150 m^2); in the collection beds of the Main Botanical Garden of the Academy of Sciences USSR (in Moscow; on a 500 square-meter area, the foci covering 75 m^2); in the collection beds of the Zonal Institute of Horticulture of the Non-Chernozem Belt (in the central department of "Biryulevo," on a 0.5-hectare plot, the area of the foci being 50 m^2); and in the department of "Izmaylovo" (on a 2-hectare plot, the area of the foci being 250 m^2). Planting stock from these organizations was shipped to a number of consumers: the imeni Lenin, "Krekshino," and "Lesnaya polyana" kolkhozes in Moskovskaya Oblast; the training farms of the Timiryazevskiy Agricultural Academy (the "Otradnoye" and the "Dubki"); the Altayskiy Fruit and Berry Experiment Station in Barnaul and its support point in Gorno-Altaysk, both in Altayskiy Kray; the Donskoy Scientific Research Institute of Agriculture (Rostovskaya Oblast); the imeni 15-letiye Oktyabrya sovkhoz in Lipetskaya Oblast; the Moldavian Scientific-Research Institute of Horticulture, Viniculture and Wine Making, located in Kishinev; the imeni Frunze sovkhoz, Tiraspol'skiy Rayon, Moldavian SSR; the Belorussian Scientific-Research Institute of Fruit Growing, Vegetable Gardening and Potato Growing, in Minsk; and the Ukrainian Scientific-Research Institute of Gardening, in Kiev. One can therefore expect that the infection will be found in all these farms (O. Z. Metlitskiy). Metlitskiy reports that in Leningradskaya Oblast the parasite has been found in the collection beds of the Pavlovskiy

Experiment Station of the All-Union Scientific-Research Institute of Plant Growing, on a 0.5-hectare plot (area of foci 100 m^2), at the Leningrad Experiment Station of Horticulture, and at the "Prigorodnyy" sovkhoz. In Ryazanskaya Oblast, Metlitskiy reports that in 1964 the nematode was present at several sovkhozes: "Aleksandr Nevskiy" (on a 150-hectare plot, with 80% infection of plants); "Ryazhskiy" (100%); "Ryazanskiye sady" (above 50%); and imeni Lenin (15%).

The losses incurred from nematode infection are very large. At the "Aleksandr Nevskiy" sovkhoz, for instance, marketable strawberries amounted to as much as 1 - 2 tons per hectare, and in 1964 the acreage under strawberries at this farm was 18 hectares. At the "Ryazhskiy" sovkhoz, before 1961, there was a predominance of mixed varieties which yielded 5 to 7 tons per hectare. In order to increase the yield, seedlings of the Russkaya krasavitsa and Rubinovaya varieties were imported from Michurinsk -- but these had been infected with the nematode. The result was that the usable crop steadily declined: in 1961 the "B. Aleshnya" sovkhoz produced 7.5 tons per hectare; in 1962, 5 tons; in 1963, 4 tons; in 1964, 2.5 tons. At this sovkhoz, 40% of plants were infected. Moreover, infected planting stock was sent to various other farms in Ryazanskaya Oblast, and also in Vladimirskaya Oblast (to one sovkhoz) and Tul'skaya Oblast (to the "Olen'kovo" sovkhoz); and we may expect to find the nematode developing there.

The Scientific-Research Institute of Horticulture imeni I. V. Michurin (at Michurinsk, Tambovskaya Oblast) in 1964 was able to produce only 1.2 tons of strawberries per hectare, despite the favorable weather. The various farms of the experiment stations of this institute (in Kuybyshevskaya, Volgogradskaya, Orlovskaya, Chelyabinskaya and Novosibirskaya oblasts) are also strongly infected with the nematode. A similar situation is observed in Lipetskaya and Saratovskaya oblasts (O. Z. Metlitskiy).

The strawberry stem nematode has been known in Krasnodarskiy Kray since 1940. At the present time it has spread through practically all of the strawberry farms of the Northern Caucasus (Krasnodarskiy and Stavropol'skiy krays, Rostovskaya Oblast, and the Kabardino-Balkarskaya, Checheno-Ingushskaya and Dagestanskaya autonomous republics). In Rostovskaya oblasts the sovkhozes under the North Caucasus Sovnarkhoz have suffered a 50% loss of strawberry crops because of extensive infection with nematodes. At the experimental farm of the Donskoy Scientific-Research Institute of Agriculture, crops of 10 - 11 tons per hectare were being harvested in 1959 - 1961, when there were only a few nematodes; but by 1964 the usable harvest had fallen to 3 - 4 tons per hectare, as a result of massive invasions by the parasite. Here, because of the large number of defective plants, two-thirds of the plantings were plowed under, as was done at the "Sad-Gigant," "Belorechenskiy," "Mikhaylovskiy pereval" and other sovkhozes (O. Z. Metlitskiy).

In the Ukraine the nematode has strongly infected the strawberry farms of the Donetsk, Krymskaya and Melitopol' stations, and of the Khersen support point of the Ukrainian Scientific-Research Institute of Horticulture.

The importation of seedlings is presumably the cause of the presence of the nematode at the experimental farms of Kiyevskaya and Cherkasskaya oblasts of the Ukrainian SSR (O. Z. Metlitskiy).

In the Georgian SSR the stem nematode attacked strawberry plants in 1962 at the nursery of the Sukhumy Experiment Station of Subtropical Plants; in 1962 it was found on the land of the Institute of Horticulture, Viniculture and Viticulture (Tbilisi, village of Vashladzhvara), and also at the Gori Experimental Center of the Skriyskaya Experiment Station of the Institute, and in Santredskiy Rayon at the village of Mnoshvili (reported by Prof. M. Ye. Aleksidze in 1964).

The strawberry stem nematode has been discovered in the Kazakh SSR (Chimkent, Alma-Ata), in Oshskaya Oblast of the Kirgiz SSR (A. M. Borovkova), and in the Uzbek SSR (O. Z. Metlitskiy).

In the Estonian SSR the parasite has been found in private plots near Tallin; in the Lithuanian SSR, in Vil'nyusskiy Rayon -- at the "Avizhane" fruit farm and at the State Fruit Breeding Farm (V. P. Yefremenko), and also at the Vitenskaya Experiment Station of Kaunasskiy Rayon (O. Z. Metlitskiy).

* * *

The clover stem nematode (Ditylenchus trifolii Skarbilovich, 1957) attacks the sprouts of both cultivated and wild clover. Strongly infected plants differ from the normal in having thickened, shorter stems. Infected buds lead to underdeveloped leaves and sprouts. Ultimately, the infected plants die.

The nematodes have been detected in the Ukrainian SSR, in both cultivated and wild clover; strong infections have been noted at Obroshino, L'vovskaya Oblast (S. V. Kapitonenko, 1962), in the Carpathians, in the Cis-Carpathians, and in the Northern Caucasus, at the village of Khamyshkin (A. A. Ustinov and V. G. Zinov'yev, 1962; V. G. Zinov'yev, 1963).

In Latvia this nematode has been found in red clover fields near the city of Yelgava, on the fields of the Priyekule Experiment Station (V. K. Eglitis and D. K. Kaktynya, 1954), and, by observers in 1959 - 1960, in the central and northeastern parts of the republic. Serious infection of second- and third-year stands of red clover, with infection of up to 50 - 58% of plants, was observed (D. K. Katynya, 1962).

Nematode infection of clover by this species was first observed in Estonia in 1963, in Pyarnuskiy and Tartuskiy rayons, by E. L. Krall'. Since no extensive studies of the clover stem nematode here have been made, one may reasonably expect that it is more widely distributed than this.

* * *

The root nematode Tylenchus radicicola (Greeff, 1872) Filipjev, 1936 attacks the roots of narrow grass, timothy and other cereal grasses; according to foreign observers it also may attack barley, wheat, rye, and oats, causing the formation of crescent-shaped galls on the roots, and halting the growth of the plant. Badly infected plants, particularly in dry periods, lag in growth; but where there is adequate moistening (as in the case of lawns), the effect of the nematodes is imperceptible.

According to E. L. Krall', this species is widespread in Estonia in natural stands of annual and biennial meadow grass, timothy (Phleum pratense), and chewing fescue (Festuca rubra). In 1961 Krall' observed the nematode in the Latvian SSR (Aymaahi), and in 1963 in the Lithuanian SSR (Shyaulyay).

The root nematode has been found also in certain places in the Ukrainian SSR: in the Carpathian Mountains, in wild cereals; in 1963 - 1964, in the city of L'vov at a children's stadium; and in L'vovskaya Oblast (A. A. Ustinov and V. G. Zinov'yev; Z. Volodchenko). In all probability the nematode is widely distributed in areas with severe climate.

* * *

Nematodes of the genus Pratylenchus attack the roots of various cultivated species -- vegetables, fruit trees, grains, potatoes, berns, strawberries, decorative shrubs, and the like. They cause necroses on the roots, which subsequently wither away. In annual species, in addition to retarded growth, there is yellowing and drying up of the leaf ends; in grains there is reduced tillering and earing, the formation of undersized ears and delicate stems.

* * *

The meadow nematode Pratylenchus pratensis (de Man, 1880) Filipjev, 1936 has been found to inflict serious damage to flax in Pskovskaya Oblast, and to the roots of the poppy and the apple (1962 Symposium).

The meadow nematode has been detected in the Botanical Garden of Khar'kov University (A. A. Ustinov and V. G. Zinov'yev).

In Lithuania, this species has been found in the carrot, the sugar beet, the onion and lettuce (Yu. Shlepetene, 1961), in various rayons: Vil'nyusskiy, Kaunasskiy, Utenskiy, Anikshtsyayskiy, Panevezhskiy, Shyaulyayskiy, Klaypedskiy, Vilkavishskiy (reports do not indicate the degree of damage).

E. L. Krall' has found the parasite in several rayons in Estonia -- slightly infecting the potato.

* * *

The penetrating nematode /Pratylenchus penetrans (Cobb, 1917) Chitwood A. Oteifa, 1951/ was first observed in the USSR by E. L. Krall', in connection with damage to fruit and berry crops: in the roots of the apple, gooseberry, and red and white currant (also in the soil adjacent the roots). As regards geographical distribution, it has been found in Pyarnuskiy and Paydeskiy rayons of the Estonian SSR, as well as in gardens in Tartu and Pyarnu. On one farm in Paydeskiy rayon, a half gram of fresh gooseberry roots contained up to 280 larvae and mature nematodes. Every year there is some drying up of the plants; sometimes, in the case of the black currant, the whole portion above ground dries up. Strongly infected stalks, particularly those of the gooseberry and the white currant, in unfavorable years will produce scarcely any fruit, or else a harvest can be obtained only periodically, with excess fertilizer.

A retarded condition is characteristic of badly infected apple trees.

This particular species of nematode has also been observed in the nurseries of the Yarvamaas, Tartu and El'vas forestry farms. The parasite is found both within and on the surface of the spruce, and in the surrounding soil. Up to 5,000 nematodes were counted in 10 grams of roots taken from infected seedlings in 1963, at the Kyarkmas nursery of the Tartu forestry farm, during autumn (E. L. Krall', 1964).

Since the nematode diseases of berry bushes and trees in the USSR are completely uninvestigated, we should launch a study of gardens and shrub nurseries in order to clarify the role of this parasitic species in other republics.

* * *

The tuber nematode (Pratylenchus globulicola Romenico, 1960) has been observed in Chelyabinskaya Oblast. This nematode attacks the nodules of roots, greatly retards root growth and the development of the portion above ground, and causes the leaves to yellow and die. The foliage and straw derived from infected plants is reduced by as much as two-thirds.

Scribner's nematode (Pratylenchus scribneri Steiner, 1943) has been observed in four rayons in Estonia, attacking the root system of the potato plant (E. L. Krall'). Another nematode (Pratylenchus crenatus Loof, 1960) has been separated (E. L. Krall') from the roots of oat plants at Kayola, Vyruskiy Rayon, Estonia (August 1959). Plants infected with this nematode were marked by their retarded growth.

Root-knot nematodes (Meloidogyne spp.) are fairly widely distributed in the Soviet Union. Their economic significance is not uniform; they are particularly harmful in greenhouses, and in the open ground of the southern republics which employ irrigation; in the central belt they are less harmful (1962 Symposium).

The damage caused by the root-knot nematodes, in addition to stunted growth, consists in the formation of swellings (galls) on the roots; these vary in size, depending upon the type of plant and the degree of infection. In the case of grasses, which are highly susceptible to the infection, the galls are larger than those formed on woody plants, which are less susceptible. Some researchers believe that the size of the galls is dependent upon the species of nematode involved.

Six species of root-knot nematodes are known in the Soviet Union; they are found in both indoor and outdoor beds, and sometimes more than one species will attack the same plant. Diagnosing the species involved is possible only for trained specialists.

The root-knot nematodes are transmitted in soil carried from one place to another, on agricultural tools, in infected plants, on clothing, and on truck wheels and in water. In some cases the nematodes are able to migrate to domestic plants from the local wild flora (A. A. Ustinov, V. G. Zinov'yev, or else the fields are infected by plants grown in hothouses (N. M. Smeshnikova).

The nematodes attack vegetables, cucurbits, potatoes, decorative plants, industrial crops (tobacco, sugar beet, cotton, essential-oil plants) and fruits. Neither conifers nor citrus trees are infected; but certain grains, for example, maize, suffer light infection (A. A. Aliyev, 1961) without structural damage.

In the RSFSR the root-knot nematodes do significant damage in hothouses in Moscow and the surrounding oblast (more than 42 farms, including the nursery of the Main Botanical Garden, Academy of Sciences USSR), Leningrad, Tambov, Voronezh and Voroneznskaya Oblast (Semilukskiy Rayon), Kurskaya Oblast, Kostroma, Gor'kovskaya Oblast (Balakhna), Kazan', Chelyabinsk, Novosibirsk, Stavropol'skiy Kray (Yessentuki), Nal'chik, Krasnodarskiy Kray (Tuapse, Sochi), Rostov-na-Donu and Rostovskaya Oblast (Aksayskiy, formerly Novocherkasskiy Rayon), Komsomol'sk-na-Amure, Khabarovsk, Ussuriysk, the suburbs of Vladivostok, and, in 1963, Ulyanovsk (1962 Symposium, N. M. Sveshnikova, N. K. Nikulina).

Within the hothouses of Leningrad the following have been found: the Java root-knot nematode /M. javanica (Treub, 1885) Chitwood, 1949/, the southern /M. incognita (Kofoid and White, 1919), Chitwood, 1949/, the cotton nematode (M. incognita acrita Chitwood and Oteifa, 1952 and M. sp.); within the suburbs of Leningrad, the southern and the cotton root-knot nematodes, and also the peanut nematode /M. arenaria (Neal, 1889) Chitwood, 1949/; within those of Simferopol', M. javanica; within those of Novosibirsk, Tomsk and Volkhov (Leningradskaya Oblast), M. incognita; within those of Sakhi, M. arenaria; within those of Moscow and Moskovskaya Oblast, M. incognita, M. incognita acrita, and M. javanica (Ye. S. Kir'yanova, 1959, 1961; T. G. Terent'yeva, 1960, 1962; L. A. Gus'kova, 1963).

In the RSFSR the northern root-knot nematode (M. hapla Chitwood, 1949) has been found in open ground. In Moskovskaya Oblast (Udel'naya and Zheleznodorozhnaya) it has strongly infected garlic plants (N. M. Sveshnikova, 1949, 1951; Ye. S. Kir'yanova, 1961); in Krasnodarskiy Kray (Sochi) it has been found in tomatoes and weeds; in the Crimea (Simferopol', Bakhchisaray, Saki) in flowering plants; on Sakhalin Island, in the potato (Ye. S. Kir'yanova, 1958, 1961); and in Gor'kovskaya Oblast (by L. P. Myshkina, identification by T. G. Terent'yeva). This species has also been observed in wild clover in the Northern Caucasus (settlement of Dzhubga, Belaya River, etc.); here it is found in thinly populated areas, penetrating far into the mountains along the river valleys; specifically it has been found in the area of Qeytkhskiy Pass, across the watershed of the range (A. A. Ustinov and V. G. Zingv'yev, identification by T. G. Terent'yeva).

In the Belorussian SSR the root-knot nematode has been recorded in open ground by O. I. Merzheyevskaya (1937), A. A. Ustinov (on valerian), and N. M. Sveshnikova, on the roots of the potato (at Mogilev). The nematode has been observed in the potato in Gomel'skiy Rayon, and in the wormwood and in couch grass in Mogilevskiy Rayon (identified as M. hapla by Ye. S. Kir'yanova, 1961).

In 1964, L. A. Gus'kova identified the infection (without structural damage) in the potato stalks of a private plot near Minsk, at Priluki.

In hothouses the root-knot nematodes have been observed only in the nurseries of the Central Botanical Garden of the Academy of Sciences Belorussian SSR in Minsk, where, in 1957 (from observations of the Republic Quarantine Laboratory) nursery plants perished after strong infection with root-knot nematodes. The infection was observed in some 400 species of plants. In 1964, L. A. Gus'kova observed root-knot nematodes in two species of figs and in the begonia.

In the hothouse compounds of Minsk, Borisov, Gomel', Vitebsk and Mogilev, no root-knot nematodes were revealed by the 1964 investigation (L. A. Gus'kova).

In the Lithuanian and Latvian SSR, root-knot nematodes are not yet economically significant, either in greenhouses or on open plots. Relevant information on this point has not been obtained from the Estonian SSR. In Lithuania root-knot nematodes were observed as early as 1923, on valerian in the collection garden of Vil'nyus university, and subsequently at various places during the period 1930 - 1948 (S. M. Mastauskis, 1955). In 1948, in studies made on private plots for the potato nematode, root-knot nematodes were found by M. M. Sveshnikova in tomatoes, cucumbers, beets, and garlic, in a number of the districts of Vil'nyus; in 1960, they were discovered in the flower nursery of the "Tamaris," whence they spread to the vegetable hothouses of the sovkhoz, being observed by V. P. Yefremenko and Ye. Kir'yanova, as M. hapla. In 1961, S. S. Klimakova found the nematode in a hothouse of the agricultural technicum of Kaunas, as well as at several private plots in the city of Vil'nyus (V. P. Yefremenko). M. hapla has also been observed in the potato in Vil'nyusskiy Rayon (Ye. S. Kir'yanova, 1961).

In the Latvian SSR root-knot nematodes were observed for the first time in vegetables in the hothouses of Riga; however, because of constant replacement, as well as steam treatment, of the soil, they have not assumed economic importance. More recently the nematodes have been observed in seven rayons of the republic, as well as on open ground in Riga, where they have caused certain damage to carrots (Eglitis and Kaktynya, 1954, 1959; Kaktynya, 1964). In Latvia, M. hapla is found in open ground (Ye. S. Kir'yanova, 1961).

The northern root-knot nematode (M. hapla) is widely distributed in vegetables and wild plants in the Ukrainian SSR -- in Ivano-Frankovskaya, L'vovskaya, Chernovitskaya, Zakarpatskaya, Ternopol'skaya, Poltavskaya, Donetskaya, Khersonskaya, and Zhitomirskaya oblasts, and also in the city of Kiev (Ye. S. Kir'yanova, 1960, 1961, 1962; A. A. Ustinov and V. G. Zinov'yev, 1961), as well as in the parks of the city of Khar'kov (A. A. Ustinov, V. G. Zinov'yev). The latter observers also found the gall nematode (species not identified) in vegetable gardens of the Donets river valley.

Root-knot nematodes do great damage in the greenhouses of the republic. The hothouses of Khar'kov are infected with M. incognita and M. arenaria, the latter species being observed also in the hothouses of Kiev and Merefa (Ye. S. Kir'yanova, 1960, 1961). Significant areas were found to be infected in the hothouses of Nizhnedneprovsk (S. V. Uslova, 1963), Dnepropetrovsk (A. A. Ustinov, 1956), Zaporozh'ye (2 farms), on the sovkhozes of Donetskaya Oblast, and on the "Teplichnyy kombinat" sovkhoz near Donetsk; in the case of the latter, some 37% of the hothouse planting area was infected (N. M. Sveshnikova).

In the Transcaucasian republics, the root-knot nematodes are of great economic significance. In the Azerbaydzhan SSR they are widely distributed, but in the form of foci. They are particularly harmful in districts with sandy soil, and in fields and private plots devoted to vegetable crops.

On the Apsheron Peninsula, root-knot nematodes are a scourge to the vegetable grower. Some fields, in fact (up to several hectares in extent), are so badly infected as to be quite useless. Such fields have been used experimentally in studies of nematode control (the Armenikandskiy Nursery in Baku, in 1948, and the Apsheron State Plot for Plant Breeding, near the settlement of Shuvelyan -- N. M. Sveshnikova, 1951, 1961). Cucumbers, and also watermelons, have perished here 1.5 months after planting, without yielding any fruit; the infection has also been noticed in tomatoes, the eggplant, and even in cultures normally less susceptible -- the potato, the onion, and cabbage. Since testing of the varieties could not be carried out on account of the nematode, the State Plot was subsequently removed to Kusarskiy Rayon. Strong damage by the root-knot nematodes was noted for vegetables; but a number of crops (mainly the fodder grasses) are quite resistant, even on strongly infected plots (S. I. Shipinova, 1954, 1961).

According to data of D. M. Sadykhov (1962), at a number of farms on the Apsheron Peninsula the loss of tomatoes from root-knot nematodes has

reached 50 - 60%, and, in the case of watermelons, 18 - 98%. At the "Buzovninskiy" sovkhoz, former Leninskiy Rayon, 40 hectares were strongly infected with gall nematodes (M. arenaria), and 127 hectares were left idle on account of similar infection; at the "Mashtaginskiy" sovkhoz 33 hectares were strongly infected; and 21 out of 46 hectares had to be left idle in one of the brigades (D. M. Sadykhov, V. S. Treskova). The gall nematodes cause great losses in the hothouses on the Apsheron Peninsula, which supply early vegetables to the local sanatoriums and rest homes (the "Buzovninskiy," "Khurdalanskiy," the auxiliary farms of "Azneft'", and so on).

The discovery of root-knot nematodes in the republic was made in 1932, when they were first observed at several points on the Apsheron Peninsula. Later on they were observed in the city of Baku (1935 - 1938), and still later in the former Tertereskiy, Geokchayskiy, Agdamskiy, and the former Kirovabadskiy rayons (Ye. V. Selivonchik, 1938). Still later the parasites appeared at a state strain testing station in Sabirabadskiy Rayon (S. I. Shipinova, 1955), and ultimately in vegetable crops in Sal'yanskiy, Masallinskiy and Lenkoranskiy rayons (G. A. Kasimova, 1958, 1964). In the last-named location the species M. incognita was found in vegetables and melons (Ye. S. Kir'yanova, 1961; G. A. Kasimova, 1964); M. javanica in tomatoes and in weeds; and M. arenaria in the eggplant and in the pepper (G. A. Kasimova, 1964).

At the Armenikendskiy nursery in Baku, as on the Apsheron Peninsula, (Ye. S. Kir'yanova, 1961), M. arenaria, M. javanica, M. incognita and M. hapla are all widely distributed, attacking vegetables, melons, shrubs and decorative plants, as well as weeds and other plant life; M. incognita acrita is also found (T. G. Terent'yeva, 1962). In Sabirabadskiy Rayon the latter observer has also discovered M. arenaria and M. javanica infecting vegetable crops, and M. arenaria in Kyurdamirskiy Rayon, close to Akhsu, infecting a number of cotton plants.

In Kirovabad (the pomological gardens of the Azerbaydzhan Scientific-Research Institute of Sericulture, and the Azerbaydzhan Agricultural Institute), M. incognita has been found in tomatoes and the eggplant; M. incognita acrita has been observed in these two crops as well as in the carrot and the gourd; M. javanica has been found in the tomato (G. M. Ismailov); and M. hapla has been observed in the lamb's quarters (Ye. S. Kir'yanova, 1961). In Shamkhorskiy Rayon, at the kolkhoz imeni Azizbekov, the nematode infected 20 hectares of sugar beet; in Kazakhskiy Rayon, M. incognita was observed in the sugar beet and in the cucumber (G. M. Ismailov).

In the Georgian SSR, root-knot nematodes do serious harm to vegetable crops in the hothouses of the former Gagrinskiy Rayon, Cape Pitsunda, and other areas, as well as to plantings in open ground. Significant damage has been noted on an open plot of the Georgian Scientific-Research Institute, where the yield of tomatoes fell to 0.9 kg per m^2 (L. A. Vachaynshvili). In Georgia five species of root-knot nematodes -- M. hapla, M. arenaria, M. javanica, M. incognita and M. incognita acrita -- have been found to infect vegetables, tobacco, tea, and the fig, as well as decorative plants and

cotton varieties -- 9123-I, 9122-I, 9070-I and 190-I. The infected plants were dwarfed, and produced a limited number of pods (Ye. I. Min'shakova, 1964). Actually, root-knot nematode infection of cotton plants was observed even earlier -- near Ashkhabad, and also at the imeni Mukhador kolkhoz (T. I. Isayenko, 1954). Apart from vegetables, cucurbits and cotton, root-knot nematodes in Turkmenia have attacked many woody plants and decorative shrubs, both in nurseries and on open ground (N. M. Sveshnikova and M. V. Blinova, 1952).

Five [six] species of root-knot nematodes have been identified in Turkmenia: M. hapla (in the tomato, at the city of Mary and in Marryskiy Rayon; and in the pepper plant, at Ashkhabad); M. arenaria, on flowering plants in Ashkhabad and Kara-Kala; M. incognita acrita, on the mulberry tree, the grape, the fig, vegetables, cucurbits and wild plants (at Ashkhabad, [illegible], Kushke and Charshou); and M. javanica -- the peach (Kerki-Etbach), vegetables and cucurbits (cabbage, eggplant, watermelon, gourd), as well as decorative and wild plants (Ashkhabad, Kizyl-Atreke, Mary: Ye. S. Kir'yanova, 1961).

In the Kazakh SSR the root-knot nematode was observed by I. F. Lisovnova as early as 1939, but subsequently went unnoticed until 1961, when M. hapla was observed by Ye. S. Kir'yanova in Alma-Alta, in the carrot, and by T. G. Terent'yeva, in the tomato, at the Pakhta-Aral sovkhoz in the former Yuzhno-Kazakhstanskiy Kray. In 1963, root-knot nematodes were observed in Chimkentskaya Oblast, and on the imeni Kuybyshev kolkhoz in Vostochno-Kazakhstanskaya Oblast, where 70% of tomatoes of the Mayak variety were lost on a four-hectare plot (oblast sector of the prognosis service). There is no doubt that root-knot nematodes are today even more widely distributed; they are therefore a proper object of attention in this region.

In the Uzbek SSR, root-knot nematodes were first recorded in Bukharskaya, Andizhanskaya and Ferganskaya oblasts. In Akhunbabayevskiy Rayon, Fergankskaya Oblast, damage to tomato crops ranged from 6 to 92%, cucumbers 16 - 70%, and cabbage 6 - 95% (A. T. Tulaganov and A. I. Zemlyanskaya, 19[illegible]; A. T. Tulaganov, 1954).

On the fields of the Central Asiatic station of the All-Union Scientific Institute of Plant Growing, near Tashkent, M. javanica, M. incognita and M. arenaria have been observed (A. I. Zemlyanskaya, 1957; Ye. S. Kir'yanova, 1960, 1962); in Tashkentskaya Oblast (Kaunchi, Tashkent), Kurumbalpakiya (Kuybyshevskiy, Kegeyliyskiy, Khodzheyliyskiy rayons), and Pastdargomskiy Rayon in Samarkandskaya Oblast, M. hapla is widely distributed in vegetable and woody plants, weeds and wild plants (Ye. S. Kir'yanova 1962).

The prognosis centers have devoted little attention to assessing the distribution and harmful effects of root-knot nematodes in the Uzbek SSR. The same may be said of the Kirgiz SSR, where, in scattered cases, M. hapla has been found in tomatoes and weeds in Chuyskiy and Kalininskiy rayons, and also in Kara-Suyskiy Rayon of Oshskaya Oblast (Ye. S. Kir'yanova, 1961).

* * * *

The group of cyst-forming nematodes (genus Heterodera Schmidt, 1871) parasitizes the roots of the potato, grain plants, the sugar beet, cabbage, the hop plant, and several other species.

Female nematodes in the roots of these plants swell up from the numerous eggs they contain; a crack is formed on the root, from which the rear, swollen end of the nematode protrudes, the parasite remaining attached to the root only with its head. The membrane of the female becomes very thick, turns brown; the animal dies and is converted into a sac filled with eggs. These sacs, or cysts, are spherical or ovoid in shape, depending on the species of nematode.

* * *

The potato nematode (Heterodera rostochiensis Wollenweber, 1923) attacks the roots of the potato, less often the tubers. When the infection is severe, the result is marked underdevelopment of the portion of the plant above ground (small number of stems, scant foliage), detachment of the root system, and consequent underformation of tubers -- only 10 to 27 gr per plant (N. M. Sveshnikova, 1951). The fruit of the tomato may be attacked. It should be pointed out that when the infection is slight, the above-ground portions suffer no damage, which is why the infection is most often observed in connection with long-established perennials, in connection with strong infestation of the soil and surrounding plants. The nematode is most harmful in sandy and poorly fertilized soil. The spherical cysts (dead females) containing eggs may be found in the surrounding soil, where they can remain viable for 10 years or longer. Recent analyses of soil have revealed even a few such cysts which are able to maintain themselves on the surface of water.

The process of migration is passive in nature. The nematodes move from place to place in infected potato tubers, and also in particles of soil attached to plants grown in infected ground (seedlings, bulbs, tubers -- such as those of the dahlia or the "keeping" varieties of potato), by way of agricultural tools, truck wheels, etc.

Until recently the potato nematode was restricted to private plots, which -- in the Belorussian SSR, for example -- comprise a significant portion of the total acreage in potatoes.

In recent years, as a result of overplanning, some infected private plots have become part of the property of sovkhozes and kolkhozes; this naturally has done nothing to help restrict the spread of the nematode or limit its danger to the national potato crop.

Actually, the range of the potato nematode has increased over that determined in the preceding (1962) Symposium. For example, the Central Quarantine Laboratory of the USSR Ministry of Agriculture (A. M. Borovkova) has observed new infection foci in the RSFSR: in Smolensk, Kaluzhskaya Oblast (Betlitsa), Pskovskaya Oblast, the Tatar ASSR (Pestrechinskiy Rayon), (Ulan-

o.o); and also in the Ukrainian SSR. There has been an increase in the total number of foci, which as of 1 June 1964 occupied an area of 1,985 hectares (Table 5).

In assessing the pests and diseases affecting potatoes, one must keep in mind the specific causative agent involved, since the nematode may be distributed in any area where potatoes are grown.

* * *

The sugar beet nematode (Heterodera schachtii Schmidt, 1871) attacks the roots of the sugar beet, fodder beet and table beet, as well as a number of other crops of the Chenopodiaceae and Cruciferae families -- the rape, false flax, etc.; it does not attack gramens, peas, or chickory, which can be safely sown on nematode-infected soil, with 8 - 10 field crop rotation.

When the infection is severe, many of the roots become "bearded." The lemon-shaped females (cysts) are visible to the naked eye on the surface of the roots. They are covered with white crystalline membranes which subsequently fall off, in whole or in part. The infected plants cluster in groups, which are evident from their dried-up leaves and dark-green inner portions; these plants lose their resilience in hot weather. The roots of infected plants are reduced in size, and contain only a fraction of the sugar content of normal roots.

Migration, as with all nematodes, takes place through the medium of the soil, roots (including those for seed), agricultural implements, and the waste products and wash water discharged from sugar refineries. There have been no reports of migration in seed balls.

In the RSFSR the sugar beet nematode has been reported from the central oblasts (Rostovskaya, Voronezhskaya, Kurskaya, Tul'skaya, Belgorodskaya), in the Northern Caucasus (Krasnodarskiy Kray), and from some places in Siberia (1962 Symposium). No new infected sites have been reported.

In the Ukrainian SSR, this species is widely distributed in areas of sugar beet cultivation -- in oblasts with a total acreage of 108 ha (Symposium of 1962). In 1963 reports were received of its presence in Donetskaya Oblast (A. A. Ustinov, V. G. Zinov'yev) and at the "626" sovkhoz in Dnepropetrovskaya Oblast, where the parasite attacked 14 - 17% of sugar beet on a 200-hectare plot (report of the Vasil'kovka prognosis center).

In Khar'kovskaya Oblast the sugar beet nematode is widely distributed on private plots, kolkhozes and sovkhozes (V. G. Zinov'yev, A. A. Ustinov). However, in the case of the eight sovkhozes investigated, the parasite was observed on only two individual plants, and in small numbers; this may be explained by the restraining influence of crop rotation.

The Belorussian SSR in 1964 reported a serious outbreak of the sugar beet nematode infection, in Kobrinskiy Rayon of Brestskaya Oblast (Oblast State Quarantine Inspection).

Table 5

Distribution of the Potato Nematode in the USSR, 1 June 1961
(Data of A. M. Borovkova, Central Quarantine Lab.)

Territorial Unit	Areas infected				
	Krays, Obl. Aut. Rep's.	Rayons	Cities	Populated Pts.	Area (ha)
RSFSR	16	15	12	117	718.0
Kaliningradskaya Obl.	--	3	8	122	394.4
Kaluzhskaya Obl.	--	1	--	1	0.12
Leningradskaya Obl.	--	4	3	22	19.8
Pskovskaya Obl.	--	1	--	1	0.36
Smolenskaya Obl.	--	--	1	--	0.65
Tatarskaya ASSR	--	1	--	1	1.1
Ukrainskaya SSR	1	1	--	1	2.0
Chernovitskaya Obl.	1	1	--	1	2.0
Belorusskaya SSR	6	20	3	117	225.1
Brestskaya Obl.	--	5	1	14	54.9
Vitebskaya Obl.	--	1	--	4	21.6
Gomel'skaya Obl.	--	2	--	2	10.9
Grodnenskaya Obl.	--	5	--	18	15.6
Minskaya Obl.	--	6	2	115	114.6
Mogilevskaya Obl.	--	1	--	1	7.7
Litovskaya SSR	--	39	8	258	573.3
Latviyskaya SSR	--	10	7	56	291.0
Estonskaya SSR	--	2	3	11	75.5

In the Lithuanian SSR the sugar beet nematode was first observed in 1932, and subsequently in 1949 on a private plot in the city of Vil'nyus, by N. M. Sveshnikova and later by V. P. Yefremenko. In 1961 - 1963 an investigation conducted by the Republic Quarantine Inspection revealed the presence of the nematode in soil samples in all (44) rayons of the republic: more specifically, at 241 populated points, and on 15,318 farms of various type (including private workers' plots in the cities, the botanical garden of the city of Vil'nyus, the Institute of Agriculture of the Lithuanian SSR, the fruit nurseries, the experiment stations, etc.). It is characteristic that the nematode was observed in 20 - 25% of analyzed samples taken in the cities and large settlements, bit in only 4.3% of those taken from rural localities. The losses suffered by private gardeners in the cities were quite heavy (V. I. Belokurskaya).

E. L. Krall' in 1961 discovered the sugar beet nematode in private gardens in the city of Tallin (Estonian SSR), in this case infecting the table beet. The roots were so small that the crop was almost a complete failure.

In the Latvian SSR, H. schachtii was observed in 1930, near the city of Tukums, and later on at a number of points (more than 10 rayons) a very large number of cysts (7,375 per 0.5 dm³ of soil) was observed in beet plots where rotation was not practiced (V. K. Elgiters and D. K. Kaktynya, 1954; D. K. Kaktynya, 1964).

In the Armenian SSR the parasite was observed at the village of Nicletovo, near the city of Dilizhan, as well as on the right bank of the Akstev river, infecting the table and the sugar beet (E. Ye. Pogosyan, 1960).

No reports of the nematode have been received from the Central Asiatic republics, where the sugar beet is an important crop.

* * *

The oat nematode /Heterodera avenae Wollenweber, 1924 (Filipjev, 1934)/ attacks the roots of grain crops (wheat, oats, barley, corn), which are severely damaged at points where they are invaded by the female parasite. As with the sugar beet nematode, brown, lemon-shaped cysts are formed, covered on the outside by a white crystalline membrane. A field will be dotted with numbers of infected sites, each up to several dozen square meters in size; the infected plants are undersized, with poorly developed ears and foliage, and on their roots there are numerous cysts. During dry months and years, large plots suffer more severely (1962 Symposium).

Damage from the oat nematode has been reported from the Bashkirskaya ASSR, where, by 1963, the parasite was discovered on all 752 farms investigated; particularly heavy damage was noted on the sovkhozes and kolkhozes of Dyurtyulinskiy Rayon (at the "Rossiya" kolkhoz the nematode was found on 83% of the area studied) and Tuymazinskiy Rayon (at the "Budyonnovskiy" sovkhoz up to 60% of the area studied). Plantings in Al'sheyevskiy, Meleuzovskiy and Chishminskiy rayons suffered less severely.

A high infection rate for wheat was noted in 1963 at the Kazangulovskiy seed experimental plot of the Bashkir Scientific-Research Institute of Agriculture: the Lyutestsens variety, on 270 hectare, suffered infection of 12 - 70%; the Saratovskaya variety, on 532 hectares, 15 - 62%. In addition to this, barley and oats, on 117 hectares, were both infected. Rye was not attacked by the parasite. In 1963 wheat was destroyed in Iskitimskiy Rayon, Novosibirskaya Oblast, in a 100-hectare plot (V. L. Borozdina). In 1964, in Novosibirskaya Oblast, the oat nematode again appeared in Iskitimskiy Rayon, at the imeni 22-yy Partsyezd kolkhoz, in a 100-hectare plot; it also attacked wheat in a 60-hectare plot, and oats in a 50-hectare plot at the "Cherepanovskiy" sovkhoz, as well as plots ranging from 30 to 110 hectares (total of 300 hectares) at the "Maslyaninskiy" sovkhoz (O. M. Zhuk).

In Latvia the oat nematode has appeared sporadically in two rayons (D. K. Kaktyna, 1962); in Estonia, in Tartuskiy Rayon and on Saaremaa Island in Kingiseppskiy Rayon, attacking weeds, wild oats and wheatgrass, among others (E. L. Krall'); and in the Ukraine (1962 Symposium).

Since the oat nematode migrates passively, by the same means used by the cyst-forming nematode, and has been observed in a number of different republics, one may expect that it will appear in many other regions as well where there is a predominance of grain crops -- particularly Siberia.

* * *

The clover-root eelworm (Heterodera trifolii Goffart, 1932) parasitizes the roots of both domestic and wild clover. It has been observed in the Estonian SSR in significant numbers (up to 1,000 - 1,500 cysts per 0.5 kg of soil) in Vyruskiy Rayon, at the settlement of Vastseliyna, and in Tartuskiy Rayon (E. L. Krall'); also in the Latvian SSR, in both red and white clover, in Bauskiy, Ogrskiy, Gulbenskiy, Balvskiy and Rizhskiy rayons, with numbers of cysts ranging up to 77 per 100 g of soil (D. K. Kaktynya, 1960).

The parasite has been recorded in the Ukrainian SSR (but without plant damage), in the Carpathians and Cis-Carpathians, and in the vicinity of Khar'kov; also in the northwestern part of the Caucasus (Ye. S. Kir'yanova, 1960; V. G. Zinov'yev, 1963), and in the vicinity of L'vov (V. G. Zinov'yev, 1963).

The hop-root eelworm (Heterodera humili Filipjev, 1934) parasitizes the small feeding roots of the hop, the hemp and the nettle. In the Soviet Union it has thus far been observed only in Zhitomirskaya and Vinnitskaya oblasts, on the kolkhozes and on the plantation of the Zhitomir Experiment Station (1949). The parasite was represented by 12 - 16 cysts per 1 cm of root, and 608 - 2,400 cysts per dm^3 of soil. Damage to the plants showed itself in pale coloration and yellowing of the leaves; whole groups of plants were affected (G. V. Dmitriyev, 1954). No subsequent information is available.

Our prognosis centers should turn their attention to hop plants, and, in the event of serious affection, conduct an investigation of this species of nematode.

Apart from the enumerated species of cyst-forming nematodes, associated with one or another degree of plant damage, one may note three other species: H. göttingiana (attacking the pea and alfalfa), H. punctata (grains), and H. galeopsidis (the hemp nettle).

* * *

Nematodes of the genus Aphelenchoides parasitize the above-ground portions of plants -- stems, leaves, ears, and even flowers and fruit. When these portions have been destroyed, the nematodes drop off into the soil, in which, later on, they may be transported to new locations. They also migrate in infected seedlings and seeds (often "quality" seeds are involved) to great distances from their starting point.

The strawberry nematode Aphelenchoides fragariae (Ritzema Bos, 1890) Christie, 1932/ attack a large number (more than 30) of varieties of strawberry; in the USSR, apparently, it has been widely distributed through the use of seedlings. The parasite dwells within the shoots. Typically, the disease proceeds in two forms. The first of these, which we can call "the reds," is the less characteristic. In this form the leaves become dark-green and leathery, with dense, deformed blades. The leaf stems lose their cilia and become lilac-red color. The plant is undersized (dwarfism). From July through September, some of the plants, in place of leaves, grow only "pips" -- smallish, often bent, thin protuberances, which are truncated; these are nothing more than underdeveloped leaf stems, with reduced blades. However, along with these abnormal formations, there are ordinary leaves which may conceal the "pips," and these should be pushed aside when a study is being made (E. M. Drozdovskiy).

The second, and more characteristic form of the disease, has been known for a long time, being described in the literature under the name of "cauliflower," from the fact that plants with underdeveloped, densely packed leaves and thickened shoots resemble small cauliflower heads. In recent years investigators have established that these particular symptoms of the disease appear only when there is generalized infection by the bacterium Corynebacterium fascians along with the nematode. They never occur in the absence of the bacterium (D. K. Kaktynya, M. Vimbalne, 1960). According to E. M. Drozdovskiy, this type of the disease occurs throughout the vegetative season. There are, however, many transitional forms linking the typical symptoms. The situation is further complicated by the fact that on many farms there may be accompanying infection with the stem nematode (Ditylenchus fragariae). One must isolate the causative factor in every given case.

In the non-chernozem belt the most susceptible varieties are the Krasavitsa Zagor'ya (the degree of infection may reach 50 - 80%), the Narodnaya, the Rozovaya, and the Komsomolka; the Roshchinskaya and Saksonka varieties have not been reported infected. Weeds, too (the cinque-foil and the buttercup), are infected, and these serve as reservoirs for the parasite.

The damage caused by the strawberry nematode is extensive. It is assumed that with infection of 50% of the plants, there is loss of up to 30% of the strawberry crop (D. K. Kaktynya, 1964; E. M. Drozdovskiy) (actually, losses for the Krasavitsa Zagor'ya variety vary from 22 to 68%, and for the Komsomolka range up to 64%).

The distribution of the strawberry nematode in the Soviet Union, according to data of the Central Quarantine Laboratory (A. M. Borovkova), is shown in Table 6. It is evident from this table that the infection foci are not uniformly distributed. In Leningradskaya Oblast, for example, there are 21 foci, but some other oblasts, and even whole republics, contain only one.

In the Belorussian SSR the nematode has been observed in Brestskaya Oblast (Pruzhanskiy Rayon, village of Lipovo), where the focus is now regarded

Table 6

Distribution of the Strawberry Nematode as of 1 June 1964
(A. M. Borovkova, Central Quarantine Laboratory)

Administrative Unit	Number of Farms: Kolkhozes & Sovkhozes	Number of Farms: Private Plots	Infected Area (ha)
RSFSR:			
Smolenskaya Ob. (city of Smolensk)	0	2	0.02
Kaluzhskaya Obl.:			
Kaluzhskiy Rayon	1	0	1.40
Kozel'skiy Rayon	2	0	14.30
Maloyaroslavetskiy Rayon	3	0	22.60
Sukhinichskiy Rayon	1	0	5.20
Ferzikovskiy Rayon	1	0	3.60
Vladimirskaya Obl.:			
Former Vladimirskiy Rayon	2	0	11.00
Muromskiy Rayon	1	0	6.30
Sobinskiy Rayon	1	0	6.00
Kurskaya Obl., Dmitriyevskiy Rayon	1	0	2.00
Tul'skaya Obl.:			
Belevskiy Rayon	1	0	4.00
Venevskiy Rayon	1	0	5.00
Former Kosogorskiy Rayon	4	0	17.20
Leptevskiy Rayon	1	0	0.35
Novomoskovskiy Rayon	4	0	11.30
Shchekinskiy Rayon	1	0	1.00
Bryanskaya Obl.	-	1	0.10
Kalininskaya Obl.	4	0	10.06
Kaliningradskaya Obl.	1	-	1.50
Moskovskaya Obl.	32	-	238.20
Orlovskaya Obl.	1	1	3.66
Ryazanskaya Obl.	2	-	19.00
Khabarovskiy Kray (city of Khabarovsk)	1	13	0.34
Leningradskaya Obl.	21	-	81.60
Gor'kovskaya Obl.	1	-	0.10
Primorskiy Kray (city of Ussuriysk)	1	1	0.10
Severo-Osetinskaya ASSR	-	1	0.05
Estonian SSR (city of Tallin)	0	24	0.10
Lithuanian SSR:			
Kaunasskiy Rayon	1	0	0.80
Vil'nyusskiy Rayon	1	0	0.80

Table 6 (Continued)

Distribution of the Strawberry Nematode as of 1 June 1964
(A. M. Borovkova, Central Quarantine Laboratory)

Administrative Unit	Number of Farms: Kolkhozes & Sovkhozes	Number of Farms: Private Plots	Infected Area (ha)
Latvian SSR:			
Balvskiy Rayon	1	0	0.003
Dauskiy Rayon	2	0	0.14
Valmiyarskiy Rayon	0	4	0.025
Gulbenskiy Rayon	2	1	0.005
Daugavpilsskiy Rayon	1	0	0.04
Yekabpilsskiy Rayon	1	0	0.132
Kuldigskiy Rayon	0	1	0.01
Liyepayskiy Rayon	0	2	0.20
Ogrskiy Rayon	1	0	0.04
Rizhskiy Rayon	1	0	0.01
Tsesisskiy Rayon	1	1	0.43
City of Ventspils	-	5	0.50
City of Liyepaya	-	2	0.20
City of Yurmala	2	2	0.135
Kirgiz SSR	2	-	6.50
Uzbek SSR	-	3	0.03
T o t a l.....	-	-	476.00

as having been liquidated. Reports have come in from the Ukrainian SSR that the disease is present in the Crimea (E. M. Drozdovskiy).

In the opinion of quarantine workers (A. M. Borovkova), the area of distribution of this parasite is growing larger, since infected seedlings -- which show no outward sign of the disease -- are being shipped far and wide over the Soviet Union.

* * *

The rice nematode (Aphelenchoides besseyi Christie, 1942) parasitizes the above-ground portion of the rice plant. The disease shows itself in browning of the ears, which are of pale coloration at the top, whence in English the disease is referred to as "whitetop." Sometimes the ears do not head fully (as with pyriculariosis), the spikelets are empty, or the grains are underweight.

The nematodes are found, in part, in the leaf sheaths, but mainly they attack the ears, from the inner side of the husks. In dry seeds the parasites enter a state of anabiosis, remaining viable for a whole year. They revivify quickly upon being immersed in water at room temperature, being therefore readily revealed by the funnel method. This nematode was first observed in the Soviet Union in 1940, in Krasnodarskiy Kray (N. M. Sveshnikova, 1951), at which time it caused heavy losses in the rice harvest (up to 26 - 61%).

According to data of the Central Quarantine Laboratory of the USSR Ministry of Agriculture (M. A. Borovkova), this nematode has been observed infecting the following varieties: Belyy skoms No. 1, Belyy skoms No. 2, Volgodonskiy, VROS 3716, VROS 213, VROS 145, Gir, Dubovskiy 129, Zolotyye vskhody, Zeravshanika 427, Zeravshanika 2586-1, Izmail'skiy 108, Izmail'skiy 102, Italika 1, Krasnoarmeyskiy 313, Krasnodarskiy 424 and 3352, Kendzo, Kubanskiy 140, Kubanskiy 508, Uzros 17, Uzros 2741, Uzros 72, Uzbekskiy 2, Ukrainskiy 46, Khodzha-Akhmat, Khun-Mao, Kyrmyzy-shaly, and Krasnocostistyy 90.

The parasite also attacks weeds -- barn grass and rice grass (A. M. Borovkova).

Damage to the rice crop from this nematode has been quite heavy in some parts of the country. The VROS 145 and Zaravshanika varieties are very susceptible, and therefore have been eliminated as seed sources. In 1964, in Khersonskaya Oblast (as reported by the Skladovskiy Observation Center), the nematode seriously infected rice of the Dobovskiy 129 and Donskoy 2 varieties (1 - 5%).

The reports of the Central Quarantine Laboratory for 1952 - 1955 (A. M. Borovkova) indicate the presence of the rice nematode in the following, within the RSFSR: Krasnodarskiy Kray (former All-Union Rice Experiment Station, Ivanovo GSU and Kurganinsk GSU, and the "Krasnoarmeyskiy" and "Tikhovskiy" sovkhozes); Stavropol'skiy Kray (Izobil'nenskiy and former Novinomysskiy rayons); Rostovskaya Oblast (Experimental auxiliary farm of the Southern Scientific-Research Institute of Hydrotechnology and Melioration and the kolkhoz imeni 19-yy Parts"yezd); Checheno-Ingushskaya ASSR (former Sunzhenskaya Oblast Experiment Station, Groznyy Experimental-Melioration Station); Dagestanskaya ASSR (one farm); Kabardino-Balkarskaya ASSR (the former Malo-Kabardinskaya Experimental Irrigation Station). For the Ukrainian SSR, the reports showed the presence of the parasite in Nikolayevskaya Oblast (Voznesensk Rice Experiment Station and the "Voznesenskiy" sovkhoz); Khersonskaya Oblast (the Machine-Testing Station); Odesskaya Oblast (Belya-

yurta Strain Testing Station), "Put' k sotsializmu" kolkhoz). For the Azerbaydzhan SSR, the reports showed the parasite at the Vartashen and Zakataly GSU (the data of G. A. Kasimova (1956) indicated it was present in Lenkoranskiy Rayon, and -- in the Tadzhik SSR -- at the Regar Strain Testing Station and at the kolkhoz imeni M. Mavlo in Pendzhikentskiy Rayon).

The rice nematode migrates in select seed material, in rice chaff (used for packing), in the hay of the rice plant, and also in soil and cleaning water.

This nematode is found in all rice-growing districts.

* * *

Among the nematodes which attack plant roots is the gall-penetrating citrus eelworm (Tylenchulus semipenetrans Cobb, 1913) -- a practice indicated by its Latin species name. This parasite causes destruction of the roots and retardation of the growth and development of citrus trees. Researchers abroad have established a connection between this parasite and the diseases of dry rot and "lightning wilt," and also with low resistance to frost. This nematode attacks all species of domesticated citrus trees in the Soviet Union.

The citrus eelworm was observed in the USSR in 1938 all along the Black Sea Coast of the Caucasus, from Sochi to Batumi; in the Crimea; and in several republics -- Azerbaydzhan, Armenia, the Uzbek SSR, the Tadzhik SSR, the Kazakh SSR and the Turkmen SSR: it affected both citrus trees grown on open ground and trench- and tub-cultivated plants (N. N. Sveshnikova, 1939, 1940; L. V. Tikhonova, 1957). In Azerbaydzhan the parasite has been observed in the former Samukhskiy and the former Kazimagomatskiy rayons, as well as in the villages of Mamusta and Alekseyevka in Lenkoranskiy Rayon (G. A. Kasimova, 1959, 1964). We have no other recent information on this nematode (since the 1962 Symposium), since no further studies have been made.

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Ectoparasitic nematodes feed on the contents of root cells, piercing them from without with a long, powerful stylet, but not actually invading the plant. Ectoparasitic nematodes, apart from this direct damage, open the way for the invasion of the causative agents of virus, fungus and bacterial diseases -- as has been demonstrated by a number of foreign researchers. Little study has been made of the ectoparasitic nematodes in the Soviet Union.

In 1934 - 1935 representatives of this group of parasites were found on the roots of the rubber-bearing tau-sahyz (Russian dandelion) /Heliocotylenchus multicinctus (Cobb, 1893) Golden, 1955a/ in Uzbekistan (Atabayevo, former Yangiyul'skiy Rayon), and in the Ukrainian SSR (at Ustimovka). A connection was established between the nematode and the maceration of the roots of the rubber plant, which had led to the death of a number of plants on the plantations (N. N. Sveshnikova, 1939). In the Estonian SSR the roots of grain plants in several cases were infected by members of this genus of

nematodes; and in Pyarnuskiy Rayon the white currant was infected (E. L. Krall'). In the city of Tartu, in the summer of 1963, nematodes (Criconemoides sp.) on the roots of the black currant caused marked desiccation of the plants (360 parasites observed in 50 gr of soil). This same nematode was found on the roots of the red, black and white currant in Pyarnuskiy and Paydeskiy rayons, though in smaller numbers. Representatives of Criconema sp. were found on the roots of citrus trees at Poti and Sochi (Sveshnikova, 1940).

Nematodes known to be virus carriers have been found near the roots of the black currant in the city of Pyarnu -- representatives of the genera Trichodorus and Longidorus, with very long rotary stylets; these were present in significant numbers -- up to 30 per 10 gr of soil (E. L. Krall').

In the Estonian forest nurseries, where spruce seedlings dried up and died, nematodes of the genera Criconemoides, Rotylenchus and Tylenchorhynchus (E. L. Krall', 1964) were found.

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There are two additional nematode species which parasitize domesticated flowering plants which should be mentioned, since reports have been received that they have also attacked agricultural crops:

The chrysanthemum eelworm /Aphelenchoides ritzemabosi (Schwartz, 1911) Steiner, 1932/. Infection of the chrysanthemum appears in the second half of summer, showing itself in the yellowing and destruction of leaves with restricted development of veins (the latter is a characteristic sign of nematode infection). Large numbers of the nematodes are picked up by any water coming in contact with such infected leaves (rain, ground water, dew), and are thus transferred to nearby plants and to the soil. The lower leaves are attacked first, then the upper; the plants become unsightly. The flowers also are frequently infected, and develop unilaterally. When the infection is massive, there are losses in the flower crop, since hundreds of buds never develop. This nematode is transported in infected plants, cuttings, and -- within the same farm -- on dead leaves and in soil and water. The chrysanthemum eelworm has been recorded at numerous flower nurseries in Moscow, Leningrad, Riga, Tallin, Minsk, Khar'kov, Sukhumi and Baku (Ye. S. Kir'yanova, 1961; N. M. Sveshnikova). It is apparently universal.

The large-flowering varieties suffer most severely -- Rayonant and Kvin-Meri; the most resistant varieties are the Podsolnechnik, the Garrison, the Dik, and the Zheltyy marstam (N. M. Sveshnikova, 1956). Other susceptible groups are the asters, dahlias, coneflowers, and members of the genera Cineraria, Delphinium and Verbena (Ye. S. Kir'yanova, 1951). There is a report that this parasite has extended itself to the strawberry (F. M. Drozdovskiy, 1964).

The stem nematode (Ditylenchus phlox idis Kirjanova, 1951) does serious harm to phlox plants; its parasitization of other cultivated plants is a possibility. This nematode causes marked deformation of the shoots, expressed in

alteration of leaf form (particularly in the upper leaves), the leaves b
converted from sessile to petiolate form, since the blade is reduced, an
retains only the central vein; and also in marked deformation of the bla
tip, in the form of protuberances, "furrows," corrugation, or in the for
of "whiskers." The stem of the plant thickens. The internodes are con-
tracted; side-by-side with normal shoots appear dwarf shoots strongly di
inguished by their external appearance. Sometimes the flowers are infec
the stems of the crown being shortened or distorted.

The nematodes invade all portions of the infected shoot. The ti
of the stem disintegrate, the shoots break off under the action of wind,
water, etc. By autumn the nematodes have made their way into the underg
portions of the plant (the whiskers), and it is in these, used in lieu o
seeds, that they are transported about the country.

This species of nematode is found everywhere phlox plants are gr
In Moscow it is found in the botanical gardens, the various parks, and
private gardens, where it attacks the Pluton, Brilliant, Ton, Mogoletm
Reynshtrom, Sbor vinogradu, Beranzhe, Bykhner, Tianan d'Ark, Vidar, Lya
Nash and other varieties (M. M. Sveshnikova, 1963). In 1964 phlox plant
in two parks in L'vov were found to be severely infected (M. M. Sveshnik
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The present survey of the distribution of the most harmful speci
of nematodes (as observed during 1963 and part of 1964, as well as earli
but not included in the 1962 Symposium), is aimed at drawing attention t
them in the form of investigations to be conducted by the workers of the
various prognosis centers, and, possibly, by the agronomists of our farm